The Magnetic Pressure in the Local Bubble Wall towards $l,b \sim 300,0$

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Magnetic Fields

- Magnetic Fields are thought to provide significant pressure terms in the ISM
- Regulate mass and energy flows through resistance of contraction
- Regulate energy flows by resisting charged particle (hot electrons) flow across field lines

Chandrasekhar-Fermi Method

- The MHD equation of motion yields two pressure-like terms containing the magnetic field. One isotropic and one negative with component only along the field line. = Tension in the field line.
- Balancing this tension against the driving force of the turbulence allows an estimate of the magnetic field strength. The Chandrasekhar-Fermi method

$$\left\langle B_{\perp} \right\rangle = \sqrt{4\pi\rho}\,\frac{\Delta v_{turb}}{\Delta\theta}$$

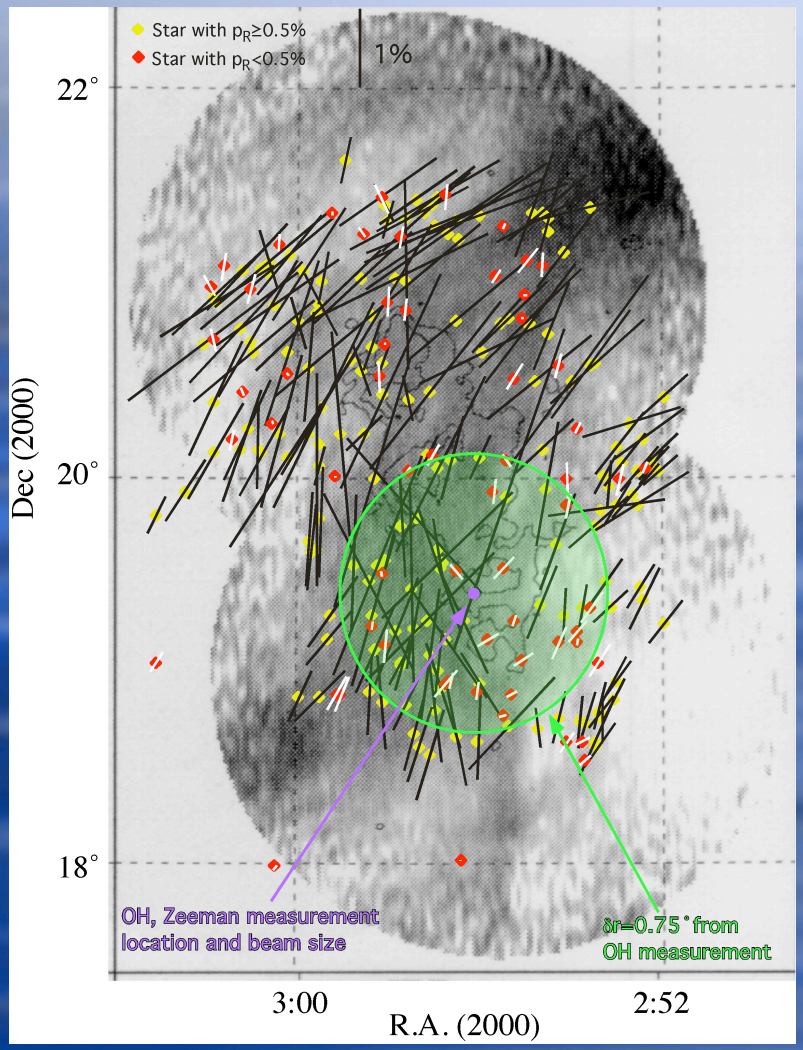
- So, measure/estimate:
- Dispersion in field direction = Position angle of polarization
- Turbulent velocity
- Space density

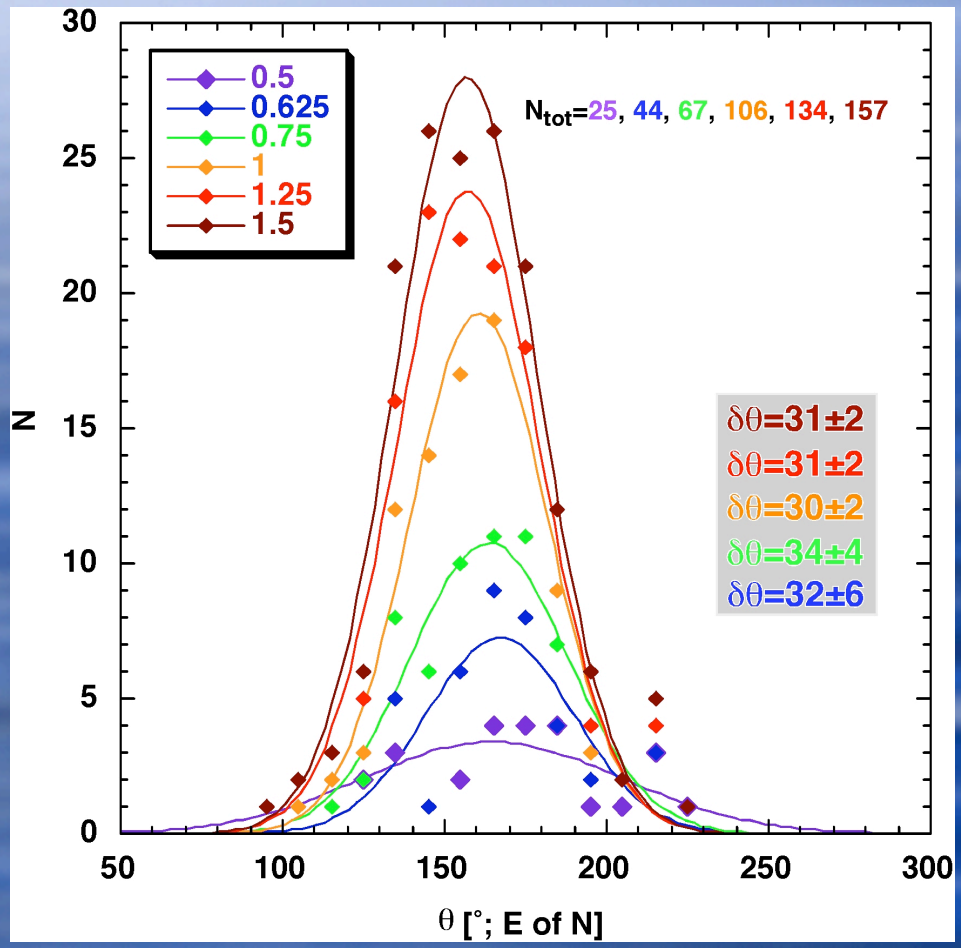
Is the CF method reliable?

Comparison to Zeeman measurement in L1457

- Few regions with high sampling density optical polarimetry and Zeeman data
- A few more with sub-mm wave polarimetry and Zeeman data (but less applicable to the LB)
- Recent OH Zeeman observations of L1457 (Troland & Crutcher, 2008) coincide with a high density polarimetry map, presented by Andersson, Vishniac & Wannier (1999)
- No direct measurement of n for L1457

CF application to L1457





H I map: Moriarty-Schieven, Andersson & Wannier (1997)

Polaimetry: Andersson, Vishniac & Wannier (1999)

Results: L1457

$$B_{\parallel}^{OH} = 13 \pm 3\mu G$$

Weighted average, 1665 and 1667 lines

$$B_{\perp}^{CF} \approx 8 \cdot \left(\frac{n}{100 cm^{-3}} \right)^{1/2} \left(\frac{\delta v}{1.2\ km/s} \right) \mu G$$

But note that for L1544, while $B_{\parallel}$(OH; Zeeman)≈11μG and $B_{\perp}$(sub-mm; CF)≈140μG, Crutcher et al. estimate that the two measurements provide consistent measures of the Importance of the field strength and differ due to differences in beam-sizes, column and space density sampled.

Magnetic Fields in the LB Wall

- Results from e.g. Leroy (1999) indicate that the LB wall carries a ordered magnetic field by showing an ordered polarization field of Hipparcos stars.

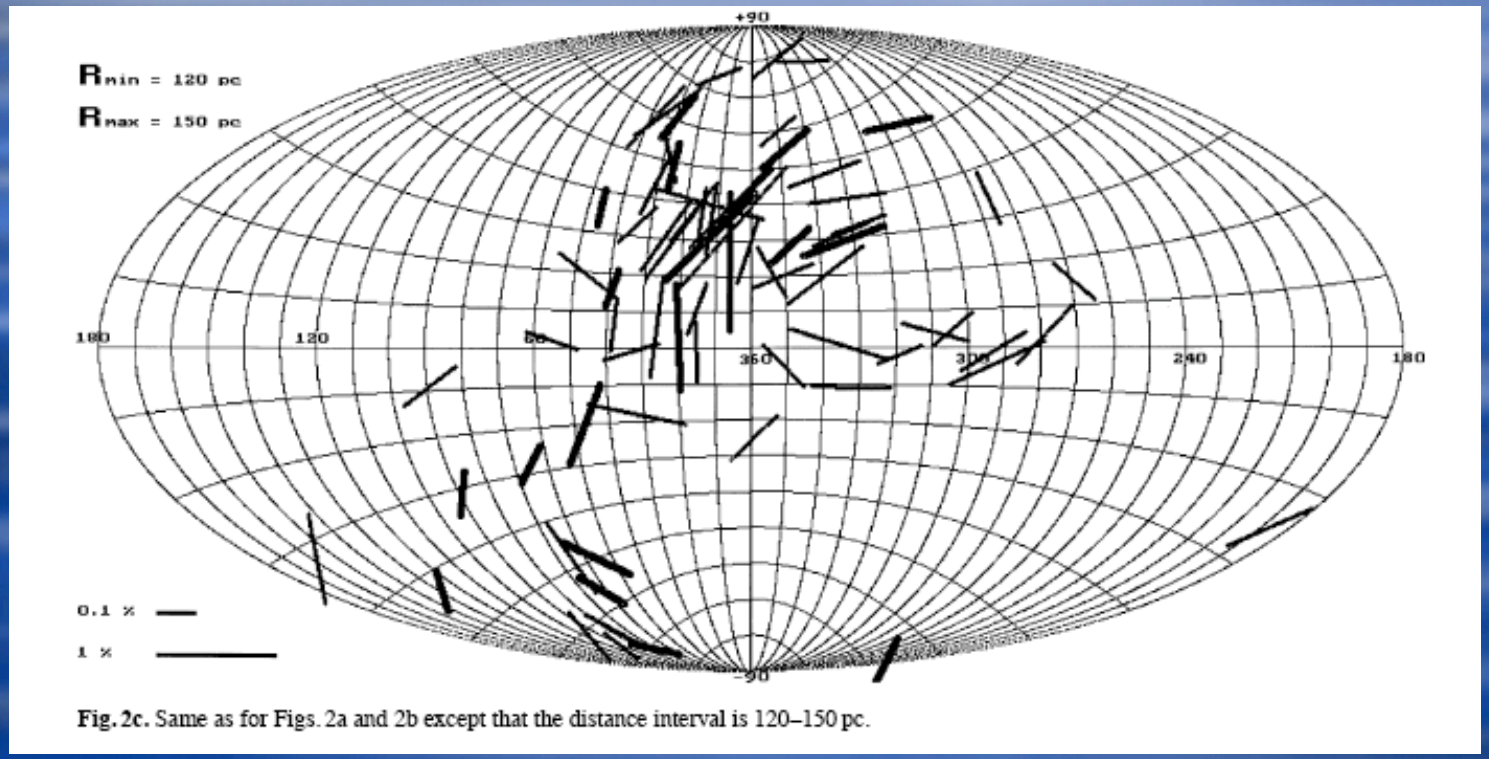
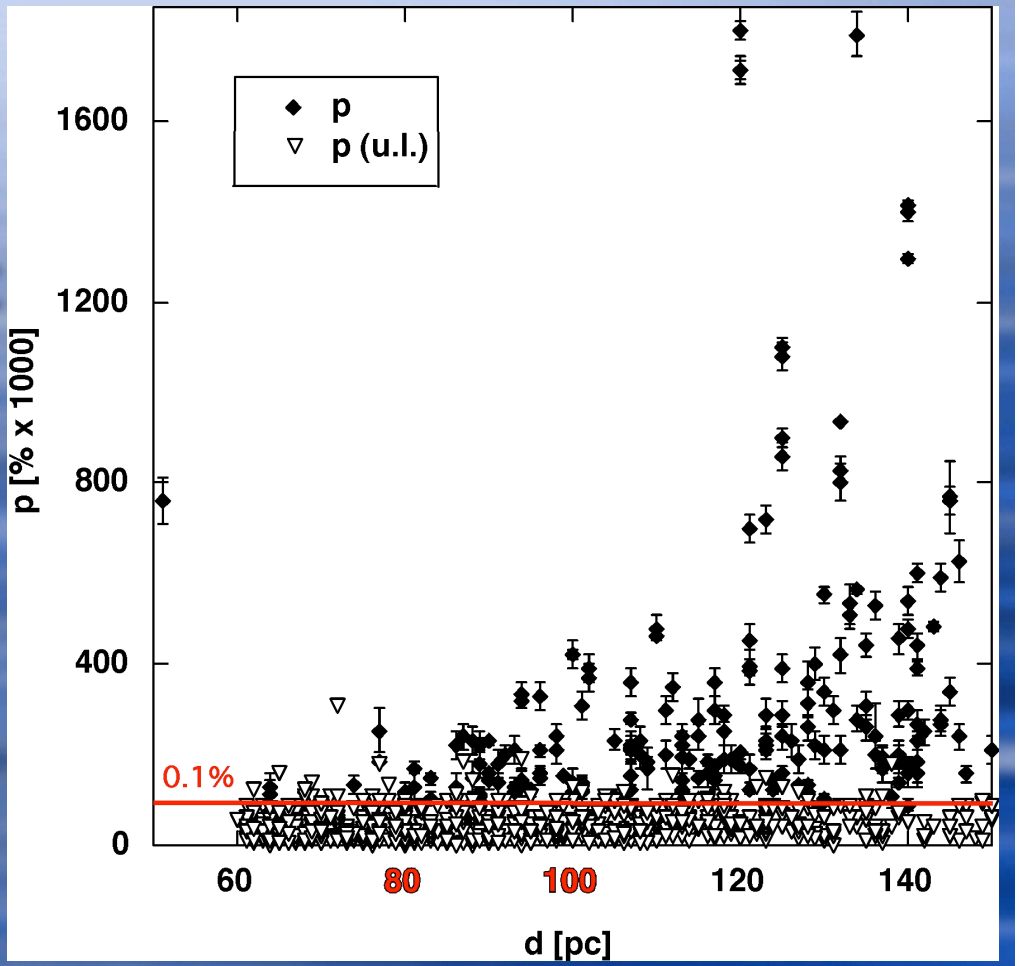


Fig. 2c. Same as for Figs. 2a and 2b except that the distance interval is 120–150 pc.

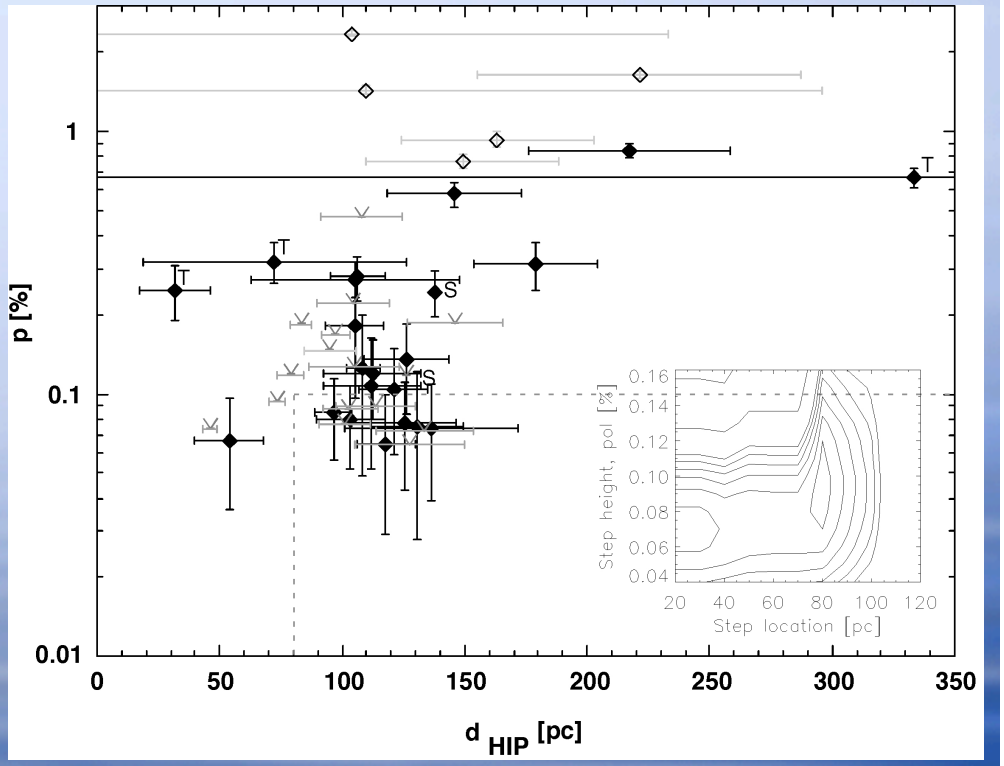
Leroy (1999) survey p vs. d

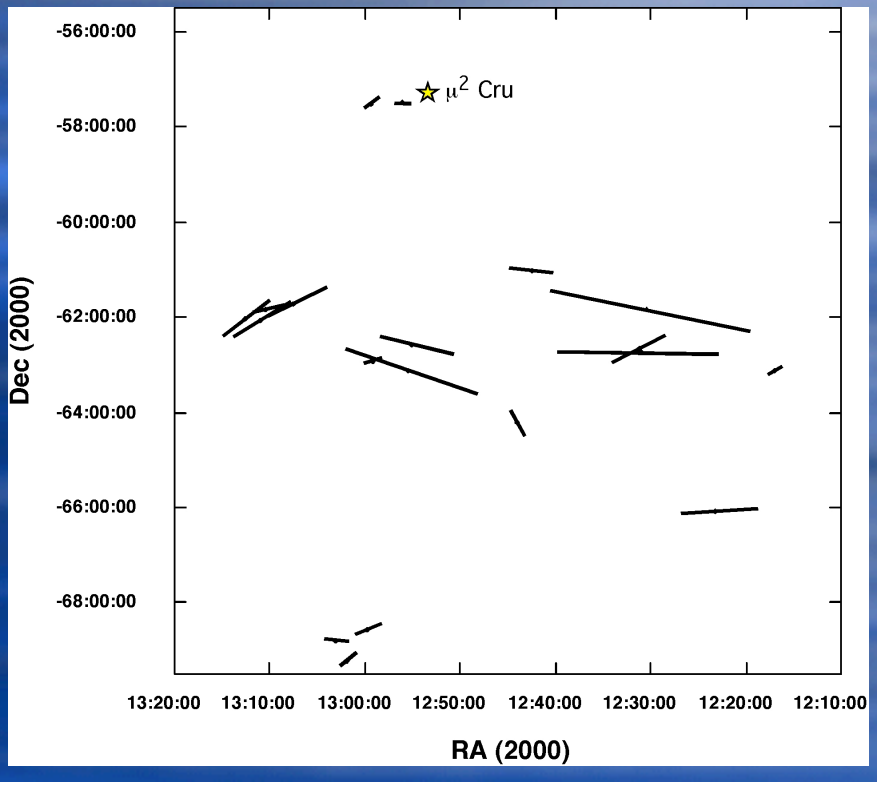
- Comparing detections and non-detections, Leroy's data shows that the LB wall likely causes the measured polarization
- His data are not high enough spatial density to allow a local CF analysis

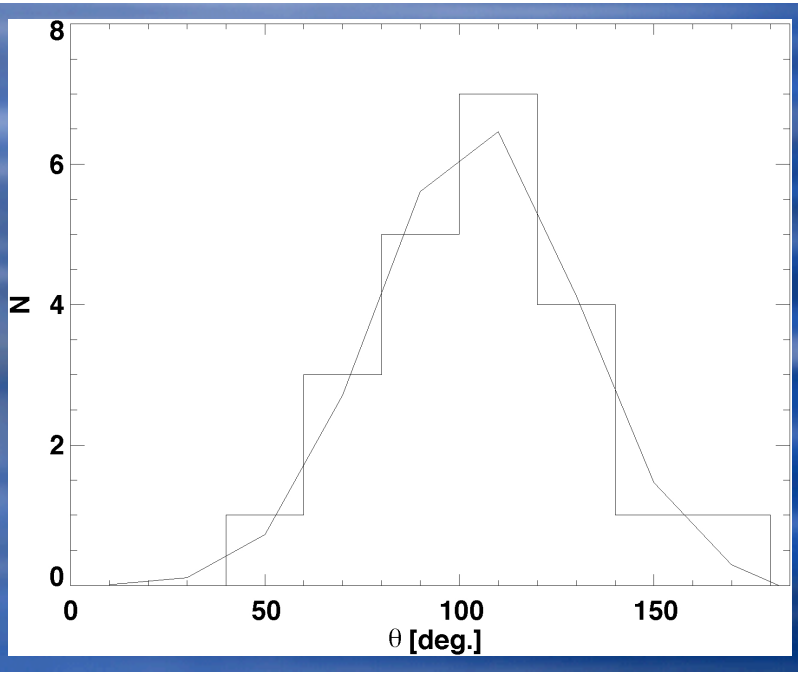


ℓ,b=300,0

- Use polarization data for stars with well determined distances, to estimate the B–field strength in the LB wall, towards $\ell,b \approx$300,0







CF results for the LB wall towards $\ell,b \approx 300,0$

- Estimate n from C I observations of μ^2 Cru (d=111±8 pc) and H_2 (J=1/J=0) excitation temperatures from LB sightlines (Lehner et al. 2003) and δv from the C I line widths.

$$\langle B_{\perp} \rangle_{LB-wall} = 8^{+5}_{-3} \left(\frac{n}{50 cm^{-3}} \right) \left(\frac{b}{1.5 kms^{-1}} \right) \mu G$$

- $P_B/k = B^2/8\pi \Rightarrow P_B/k = 18{,}000$ K cm^{-3}
- $M_A \approx 0.5$